

## APPENDIX B

### INTERPRETING AND TAILORING MIL-STD-2549

QUESTIONS THIS APPENDIX WILL ANSWER	Para.
1. What is the purpose of the data model?	B.2
2. What is a data model? What elements comprise the model?	B.2, B2.1-B2.3
3. How does the data model aid in the communication of configuration management information?	B.2, B.2.1-B.2.3
4. How can the Government acquisition manager specify the configuration management information requirements to be included in an RFP/Contract?	B.3
5. How can a contractor's automated configuration management system be evaluated to determine if it is adequate to meet the Government's information needs?	[See 5.3]

#### B.1 Scope.

This appendix provides guidance on the use of **MIL-STD-2549**. **MIL-STD-2549** has two distinct purposes. The first purpose is to provide a standard conceptual schema or data model for the Government CM Process. The second purpose is to provide the means of defining specific information to be directly input into a system designed in accordance with the data model, known as a CM AIS, by tailoring the information packets defined in **MIL-STD-2549**.

The Integrated Definition (IDEF1x) modeling technique used to define its configuration management data model is explained for a functional manager (as opposed to a data processing professional). Only those aspects of IDEF1x modeling necessary to read and interpret the key based entity relationship level (**MIL-STD-2549 Appendix B Figures**) and the fully attributed level (**MIL-STD-2549 Appendix B Tables**) are discussed. [For a detailed exposition on IDEF1x refer to **FIPS 184**.]

Guidance for tailoring the information packets defined in **MIL-STD-2549** is provided in **Section 6 and Appendix A of MIL-STD-2549**. This Appendix, in conjunction with **Section 5** of this handbook, provides additional guidance and examples to aid in the appropriate selection of the applicable sub-packets necessary for given configuration management information to be supplied.

#### B.2 Data Model Principles and Concepts

An IDEF1x data model depicts information requirements within a defined scope. It answers the question, "What kinds of information must be available to perform a defined task?" The model is not a system design, nor does it reflect the user interface, rather as shown in **Figure B-1**, it is the conceptual basis for both, known as a conceptual schema.

A conceptual schema is considered a logical data base as opposed to a physical database because it explains logical relationships. Like a performance specification for a product, it enables different solutions (physical data bases) to be implemented. Its purpose is to standardize the information elements so that data can be shared between the Government and any other user systems that employ the schema, regardless of their specific individual system data base designs. Additionally it provides a basis for mapping an existing system's elements to the Government's information requirements.

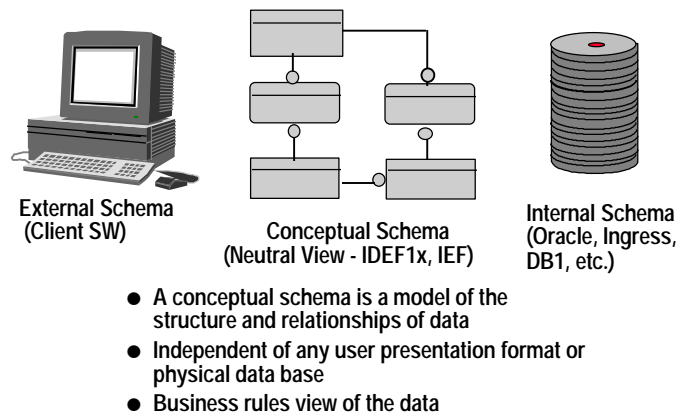


Figure B-1. Role of the Conceptual Schema

### B.2.1 Specific Concepts, Features and Business Rules in the CM Data Model

Specific concepts, features and business rules of the CM data model that may be helpful in understanding some of its complex relationships are as follows: [Detail: MIL-STD-2549, Section 4]

- **Current Document Control Authority (CDCA) and Application Activity** concept [See 4.1.1.1]
- **Document/Document representation** paradigms
  - A document is uniquely identified by a combination of document source (e.g., cage code), document identifier (number or title) and document type plus a revision identifier
  - Each document iteration (revision) has one or more document representations [See 7.2.1] which are identified by a document representation identifier and document representation revision identifier in addition to the unique identifier of the document that it represents
  - Each document representation is composed of zero or more files (a paper representation has no files but the word processing file that produced it does)
  - The same file can be used by different documentation representation revisions of a given document as well as by representations of a different document.
- **Generic document concept** - [See 7.3.1]
- **Part paradigm**
  - A part is any physical item identified by its design source and a part identifier
  - A physical part is always defined by an associated design document or model. Part models have revisions (versions) and associated files
  - A part identifier; the part identifier can be, but typically is not, the same as the identifier of the design document or model. The design document revision identifier is not part of the part identifier if the design source is a CAGE or an organization, but may include it if the design source is a company name.
- **Software paradigms**
  - For purposes of Configuration Management and data storage, software is treated by the data model as though it were a document rather than as a part. Conceptually software is considered a document of the type "software."
  - Software relationships are captured by the data model only at the end item (CSCI) level
  - Each software revision (version) is identified with a revision identifier
  - Source and executable code are treated as different document representations of the same software revision

For hardware/software integration, software is treated as a part and there are alternate paradigms to allow for different methods of identification and iteration that are commonly in use commercially

### B.2.2 Model Representation and Components.

The IDEF1x standard defines the standard way the elements of the data model (entities, attributes and relationships) are represented in the components of the model (entity tables, graphic entity relationship diagrams and the data element dictionary). **Figures B-2 through B-8** illustrate how to interpret the information in each of these components. *The content of these examples, such as entity and attributes names and table numbers, are used for illustrative purposes only; they may differ considerably from the actual content of MIL-STD-2549.* For those familiar with physical databases, it is also important to note that entities and attributes in the conceptual (logical) database) do not map one-to-one to physical databases and fields, but are similar in concept.

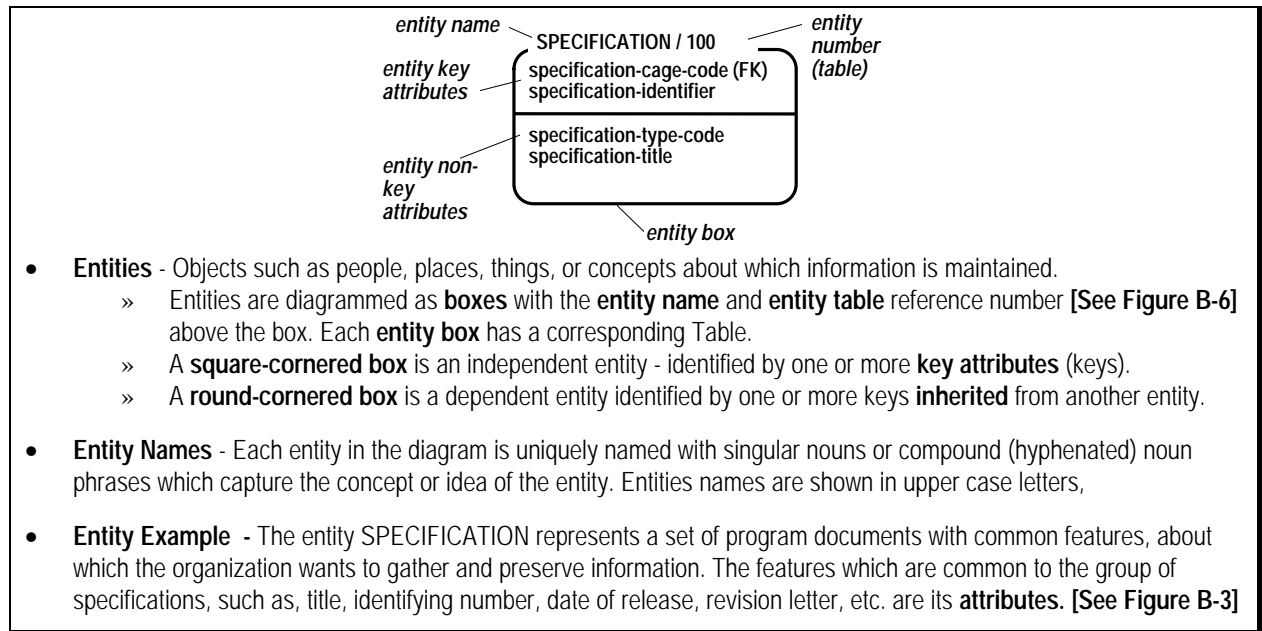


Figure B-2. Representation of an Entity

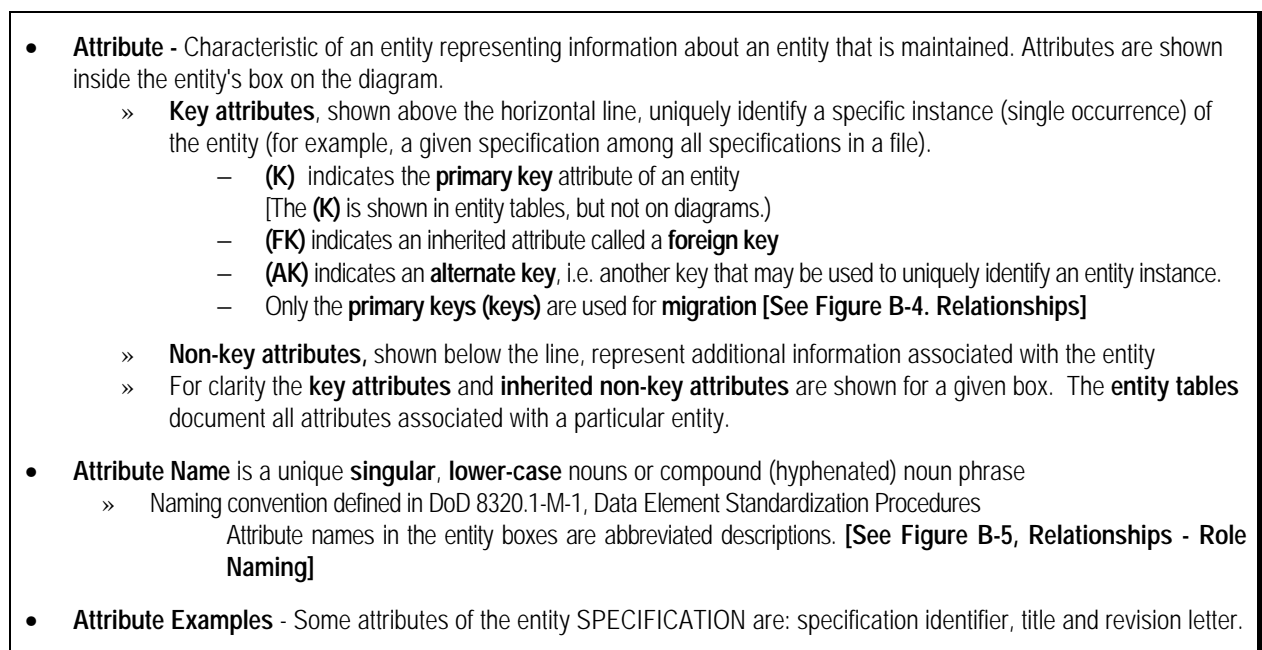
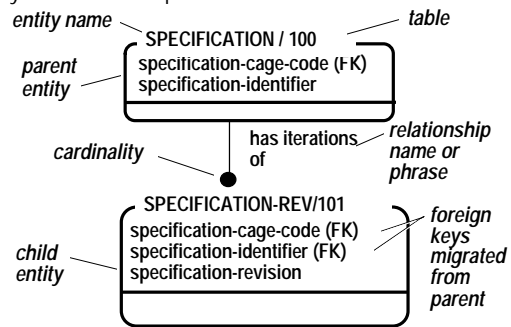


Figure B-3. Representation of an Attribute

- **Relationship** - A **business rule** describing how entities interrelate in the performance of organizational activity. A data model in MIL-STD-2549 (the graphic diagrams and related table descriptions) constitute an IDEF1x model at the fully-attributed level in which, precise business rules are defined by the relationships between entities:

- » Relationships are depicted as **connecting lines** between entities
- » The entities and their relationships can be read as sentences. The verb or verb phrase written on or near the line states the **business rule** for the relationship
- » The connecting relationships at these levels are termed as **specific**. Non-specific (many-to-many) relationships are not allowed. [See Associative entity relationships, below.]

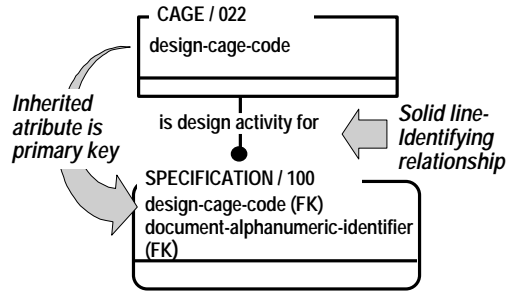


- **Relationship Examples** -

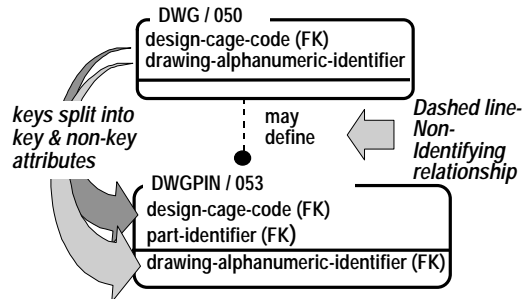
- » A SPECIFICATION **may define** a PART
- » A PART **may be defined by** a DRAWING
- » Each CAGE **may be the design activity for** zero, one or many SPECIFICATIONS

- **Relationship Types** - The relationship lines indicate the type of identity relationship between the entities and the connection (migration-inheritance rules) between keys of the entities. A **Relationship line** between two entities may be solid or dashed, and has a solid ball at the terminal end.

- » Relationships are read toward the **solid ball**
  - In all MIL-STD-2549 relationships the **solid ball** is the **child** end
  - Each child must have at least one **parent**, except in an optional non-identifying relationship
- » A **solid line** represents an **identifying relationship**.
  - The **child's keys** (set of identifying attributes) include the key attributes of the parent as foreign keys, i.e., the parent's keys are **migrated** to the child.



- » A **dashed line** represents a **non-identifying relationship**:
  - The child entity is existence-dependent on the parent entity, but is identifier-independent
  - All the foreign keys inherited from the parent are **non-key attributes** of the child, or the parent's keys migrated to the child are split into key and non-key attribute



- » A diamond symbol (◊) at the parent end of a dashed connecting relationship line identifies an **optional non-identifying relationship**:
  - The child is existence-independent of the parent; an instance of the child may occur without a related instance of the parent
  - The parent's keys may be inherited as non-key attributes

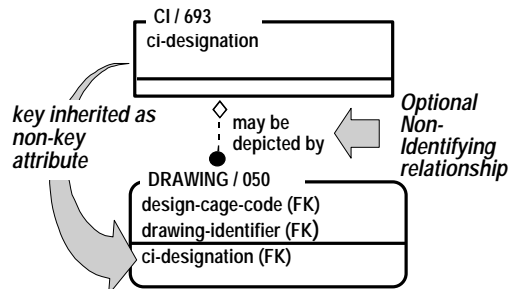
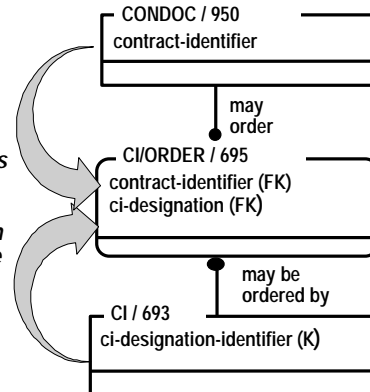


Figure B-4. Entity Relationships, Page 1 of 2

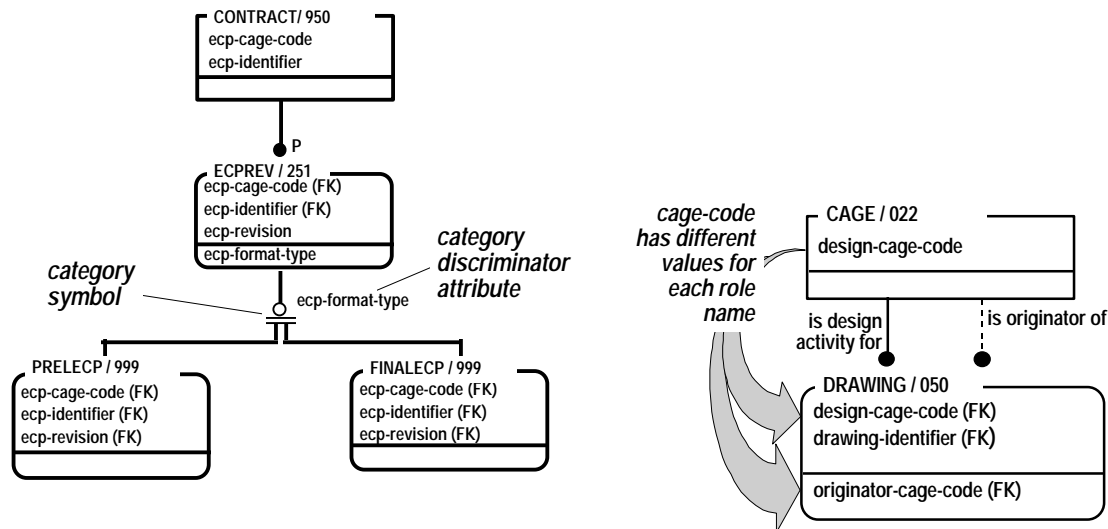
- **Relationship Cardinality** - indicates the number of instances or entries that a child entity may have in relation to its parent entity, as follows:

Notation	Number of instances
—●	Zero, one or many
—● P	One or many (P for positive)
—● Z	Zero or one
—● N	Exactly N, where N is positive
—● N-M	A range, where: N is a zero or positive integer M is positive

*Associative entity relates many contracts to many CIs on a one to one basis*



- **Associative Entity Relationships** - "Many-to-many" relationships are resolved by **associative entities** which make it possible to identify each instance of an entity.
- **Entity Categories Relationships** - Categories are used when the same kinds of information are kept about an item, but some things differ depending on status, type, or some other feature.
  - » The **category symbol** is a circle with one or two lines under it.
    - **Two lines** indicates that all of the possible categories have been listed.
    - **One line** indicates that there may be other categories, but they are not all listed
  - » A **category discriminator** is an attribute that distinguishes one category entity from another.
    - It is always an attribute or an ancestor of the item being categorized (generic entity)
    - It may, or may not, be a key attribute
  - » The relationship is always read from the generic entity to the categories entities
    - If there is a single line in the category symbol there are more categories than are shown. Read as "may be either...or," as in "The ECP at a revision may be either a preliminary or a final ECP."
    - If there is a double line, all possible categories are shown. Read as "is either...or," as in "The ECP at a revision is either a preliminary or a final ECP."



- **Role Naming** - When a relationship exists that causes a key to be migrated more than once into the same entity, the inherited attributes are given **role names** in the child entity to avoid confusion. Role names may also be used with single occurrences or a combination of inherited attributes to be more precise or place the attribute in the proper context.

Figure B-5. Entity Relationships, Page 2 of 2

*The end result of applying the techniques described previously is a set of relational tables that contain the logical definition of a database and the business rules associated with the data. The relational tables describe the logical relationship of data elements for the database (i.e., the what) not the physically implemented database (i.e., the how).*

**Example: Table 051, Engineering Drawing Revision Definition (DWGREV).**

**↙ table description and rules**

This table is the history of the various revisions to an engineering drawing or associated list. It is one subtype of Table CAGE-NUM-DOCREV/023 for the same case as the instances in Table CAGE-NUM-DOC/022, which is a de facto parent. This table also contains characteristics about the drawing, such as total sheets and sheet size.

- a. If the separate-parts-list-document-code (SEPCOD051) has a value of 'S' or 'I', then the administrative-control-drawing-document-type-code (CONTYP051) must have a value of 'N'.
- b. Because this table is a de facto child of Table 050, document-source-enterprise-defense-logistics--assigned identification-code (SRCCAG022) inherited from Table 023 is really a design-enterprise-defense-logistics--assigned identification-code (DESCAG050) existing in Table 050. Therefore, SRCCAG020 assumes the identity DESCAG050.
- c. Attribute document-generic-revision-identifier (DOCREV011) inherited from Table 023 assumes the role document-alphanumeric-revision-identifier (DOCREV051)
- d. Because this table is a de facto child of Table 050, document-alphanumeric-identifier (DOCNUM020) inherited from Table 023 is really a engineering-drawing-document-alphanumeric-identifier (DWGNUM050) existing in Table 050. Therefore DOCNUM020 assumes the identity DWGNUM050

**data element code**



**data element dictionary index number**



<u>CODE</u>	<u>DATA ELEMENT TITLE</u>	<u>DED</u>	<u>KEY</u>
DESCAG050	design-enterprise-defense-logistics--assigned-identification-code	0001	FK
DOCREV051	document-alphanumeric-revision-identifier	0009	FK
DOCTYP010	document-type-code	0004	FK
DWGNUM050	engineering-drawing-document-alphanumeric-identifier	0003	FK

**key attributes**

**non-key attributes**

CONTYP051	administrative-control-drawing-document-type-code	0032	M <sup>1</sup>
DWGSHT051	document-sheet-total-quantity	0110	
DWGSIZ051	document-sheet-size-code	0112	
FRSTR051	materiel-item-first-article-test-code	0077	
SEPCOD051	separate-parts-list-document-code	0025	

<sup>1</sup>a non-key attribute is mandatory

**Figure B-6. Entity Tables**

All the entities and attributes used in the data model and the characteristics about each attribute necessary to unambiguously define and describe it are included in the Data Element Dictionary (DED), Appendix C of MIL-STD-2549.

**Example: Data Element Definition - CAGE Code Identifier.**

*data element definition (DED) reference number*

*DED name (corresponds to  
↙ attribute name in table)*

<b>DED TITLE or ROLE TITLE</b>		<b>Type</b>	<b>Jst</b>	<b>Dec</b>	<b>Size</b>
<b><u>DED</u></b>	<b><u>Definition and Legal Values (if any)</u></b>				

0001 enterprise-defense-logistics--assigned-identifier-code

C F 5

↙ *data element field form  
(See Note 1 below)*

↙ *definition*

The standard code which represents and/or denotes a commercial or government entity or enterprise that manufactures and/or controls the design of items supplied to a Government Agency. United States and Canadian entities are designated by a commercial and government entity (CAGE) code while North Atlantic Treaty Organizations (NATO) are designated by a NATO Supply Code for Manufacturing (NASCM). Codes are listed in the Defense Logistics Agency Handbook H4/H8. This code has formerly been known as the Code Identification (Code Ident) and the Federal Supply Code for Manufacturers (FSCM). Must be digits or uppercase letters excluding the letters I and O (source of requirements: DLA Handbook H4/H8.) This DED is used in the following Tables: 003, 007

This DED is used as part of the following DED string(s):

↙ *cross reference to  
where the DED is used*

<b><u>DED</u></b>	<b><u>TITLE</u></b>
0245	modification-kit-product-identifier

*role name & definition (one of many)*

↙

**assembled-product-design-enterprise-defense-logistics--assigned-identification-code**

The CAGE which denotes the design activity responsible for the design of an assembly. This DED is used in the following table(s): 236, 239, 293, 369.

**Notes:**

1. **FIELD FORMAT**

**Type**

**B** = bit-map  
**C** = any ASCII characters  
**D** = date  
**FLPT** = floating point real number (3.25E-5, 5.3x10<sup>12</sup>)

**FXPT** = Fixed point number (1.3, -2.59, 0.003, etc.)  
**I** = integer (1, 2, 3, -5)  
**S** = string of separately defined fields concatenated in indicated order

**Justification (Jst)**

**L** = Left, **R** = Right, **F** = Full - those which occupy entire field

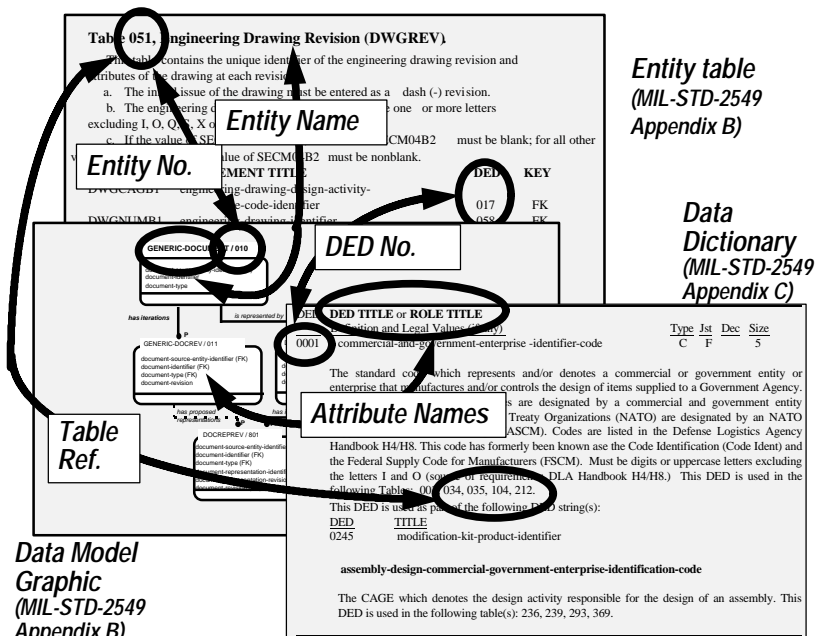
**Decimal placement (Dec)**

Number of characters to the right of the assumed decimal point

**Size**

Number of character positions, if length is variable, maximum is shown

**Figure B-7. Data Element Dictionary**



### Figure B-8. Relationship of the Model Components

### B.2.3 Suggested Approach to Reading CSA Model Diagrams

Each diagram represents a view of one subset of the data model. At first glance some of the diagrams in MIL-STD-2549, Appendix B may seem overly complex. This complexity is brought about by the multiple relationships that exist in the Configuration Management data itself and the various existing business rules related to this data. However, familiarity with the basic principles given in prior sections and use of the guidelines below are intended to reduce this complexity. The steps given below are suggested in reading the model diagrams.

1. Review the diagram as a whole to gain a familiarity with the topic being covered; scan it to gain a familiarity with the subject but avoid trying to understand it all-at-once. The title of the diagram indicates its subject area and the table description delineates what the table represents.
2. Look for the central entity table(s) of the diagram and determine groupings of related tables that connect (are related) to the central table(s). In many instances the table numbers and titles may be used to help establish groupings. For example, note that all of the tables directly related to a program unique specification are labeled by a number in the range "100 - 149". In most cases, the first numbered entity table in the series is the central table for the entity under consideration.
3. Select one of the groups and proceed from the central table to each related table. Refer to the table descriptions to resolve abbreviations used in the diagrams and to determine the detailed contents represented by the table boxes.



### B.3 Tailoring MIL-STD-2549 Information Packets

The primary purpose of MIL-STD-2549 is to standardize CM data elements and relationships so that eventually CM systems, regardless of their operating systems, input/output design, type of computer data base, or location, will have a common basis for exchanging CM information. To accomplish that purpose, the standard provides a data model (Appendix B of MIL-STD-2549) and data element dictionary (Appendix C of MIL-STD-2549). It also provides the means for defining the CM information that must be acquired to populate a CM data base. With cancellation of MIL-STD-973, MIL-STD-2549 will be the only DoD source document for CM data requirements. The data acquisition components of MIL-STD-2549 are Data Information Packets which follow Section 6, Appendix A which provides tailoring guidance, and associated data item descriptions which are listed in Section 6.

MIL-STD-2549 is designed to enable the Government tasking activity to order CM information from either contractors or other government performing activities. The data requirements associated with MIL-STD-2549 constitute the total set of information that would be needed to fully populate every field in a total fully utilized CM data base constructed in accordance with its conceptual schema. They also encompass the aggregate information needs for all phases of a program life cycle. Obviously all of this data is not invoked for a single contract or tasking directive, only a carefully selected sub-set is applicable.

The forward and scope of MIL-STD-2549 clearly state that the standard cannot be invoked on contract as a whole and that if it is cited as a requirement in a contract, without tailoring, the requirement is not binding. MIL-STD-2549 is not intended to be directly referenced in a contract or tasking directive. The only way that it is to be invoked is through the data requirements of the contract.

This section contains supplementary information considered too detailed and explanatory to be contained in the MIL-STD. It describes the methodology and gives guidance on how to select appropriate data items to put on contract or in a tasking directive. This action is an important part of the CM planning process. [See Section 2 and Appendix A] The elements involved in the process and their use are described in **Table B-1**, and illustrated in **Figures B-9, 10 and 11**.

**Table B-1. Elements in Tailoring MIL-STD-2549**

Tailoring Element	Where Located	Purpose/Use
❶ Table A-I	Appendix A	Provides guidance on types of data to select for ordering Purpose is to limit CM data across the program life cycle so that data is only ordered when applicable. Since there is variability or overlap in the functions that are performed in the various 5000.2R phases, selection considerations are keyed to the table's design maturity line which reflects the type of activity performed. The selection criteria are categorized by, non-reparability or reparability, and then whether the acquisition is performance or design based. In each column, for each item of data listed, the selection guidance is blank (normally not required), E (essential), R (Recommended) or O (optional). For simplicity recurring data /revisions which may occur later in the life cycle are not shown but are implied. Table A-I provides a Para. Ref. to Item ❷
❷ Tailoring Para.	Appendix A, Para. 4.2 through 4.8	Provide selection and tailoring guidance for each data type listed in Table A-I. These paragraphs provide further definition of the data type and amplify its purpose and use. They also provide tailoring guidance and include to Items ❸ and ❹
❸ Tailoring Tables	Appendix A, Para. 4.2-4.8, Tables A-II through A-XIV	Provide a decision process for arriving at the specific references and language to specify in the SOW or tasking directive, and Contract Data Requirements List (CDRL). The decision criteria vary by type of data but generally are related to whether originals or copies are required, delivery or access is desired, electronic data interchange is to be acquired, whether the acquisition is internal

Table B-1. Elements in Tailoring MIL-STD-2549

Tailoring Element	Where Located	Purpose/Use
		to the military component or external (acquired by contract). At the exit end (right column) of each table are references to Item ④
④ Tailoring Notes	Appendix A, Para. 4.2 - 4.8, in sub-para. "Tailoring"	These alphabetized notes provide recommended language to be specified in the Statement of Work (SOW) or Tasking Directive as well as the specific DID ⑤ and DIP/Sub-Packets ⑥ to be invoked.
⑤ Data Item Descriptions (DIDs)	Referenced in Section 6	Six DIDs are referred to in MIL-STD-2549. These DIDS refer to an associated DIP, and list the sub-packets that are included in the DIP. ⑥
⑥ Data Information Packets (DIPs)	DIPs 1 - 10 (In MIL-STD-2549 between Section 6 and Appendix A)	<p>The data information packets are tables that provide:</p> <ul style="list-style-type: none"> <li>• The data elements (fields) for selected data types and sequence of data element transmittal ⑦,</li> <li>• The labels (tags) ⑧ to precede each data element in the transaction string, and</li> <li>• References to specific instructions regarding the field content. ⑨</li> </ul> <p>The packets are organized into sub-packets, each of which is represented as a column (1A, 1B, etc.). The sub-packets in a given packet represent data that share common data elements.</p> <p><b>Note:</b> DIPs 8 through 10 represent requirements that apply to all or most data and are invoked automatically as part of the fields referenced from the other DIPs. DIPs 8 through 10 do not have corresponding DIDs.</p>
⑦ Sequence and Data Field Names	Each DIP	Common names for the data elements are used wherever possible. A given field applies to each sub-packet as indicated by the Blank, M (Mandatory) or O (Optional) listed in the sub- packet column. The sequence numbers provide the order of transmittal; fields that do not apply to the specific sub-packet are omitted from the transaction.
⑧ Field Labels	Each DIP	Each data element in the transmittal stream is preceded by a tag that identifies the location for the data element in the model. Placing the data in that field will populate the parent and child relationships of that entity as well. The tag consists of a table number (Appendix B entity table) and element identifier. Where there are variables depending upon sub-packet or other parameters, further references to footnotes, to the DIP table and to content instructions ⑨ are given.
⑨ Data Field Content Instructions	References in the DIP Table Right hand column.	These instructions are provided to clarify the content of the fields, for example, which Table.element applies for a given sub-packet, which Table.element applies in a given circumstance, which fields are repeated as a set when there is more than one instance of a data element, etc. References are made to paragraphs within the DIP, to entity tables in the data model (Appendix B), and to specific DEDs in the data element dictionary (Appendix C), as required to discriminate or determine acceptable values.

**1 Table A-1. Guidance on types of data to order**

Acquisition Life Cycle Phase		Program Definition & Risk Reduction		Engineering & Manufacturing Development				Production, Fielding/Deployment & Operational Support and Demilitarization & Disposal						
Design Maturity		System Definition		Allocated Performance Definition		Design Definition		Production, Operations and Support			Operational Support			
Nonrepairable (NR) / Repairable (R)						NR		NR			NR			
Performance-Based (P-B) or Design-Based (D-B)		P-B	D-B	P-B	D-B	P-B	P-B	D-B	P-B	P-B	D-B	P-B	P-B	D-B
Paragraph	Type of Data													
A.4.2.2	Program-unique system performance specification	E	E											
	Program-unique top level allocated performance specification			E	E									
	Program-unique lower level allocated performance specification													
	Program-unique product design specification													
	Revisions to previously acquired specifications													
A.4.2.3	Standardization documents	O	O											
	Revisions to previously acquired standardization documents													
A.4.2.4	Software & software administrative information													
A.4.2.5	Software													

**Indicates degree to which data should be considered:**  
E = Essential  
R = Recommended  
O = Optional

**2 Para. providing selection and tailoring guidance:**

- Selection - When and how data are typically used
- Tailoring (e.g Tables A-II through A-IV) **3**
  - Originals or Copies
  - Delivery or Access
  - Electronic (Yes/No)
  - Internal tasking or External Buy
  - Other pertinent discriminators for the subject type of data
  - Reference to Notes for tailoring SOW, Internal Tasking Directive, CDRL

**4 Note to Tailoring Table Cites:**

- SOW/Tasking Directive language
- Applicable Data Item Description
- CDRL Tailoring invoking
  - Applicable Data Information Packet/Sub-packet (DIP)
  - Specific tailoring instructions

Figure B-9. Selection and Tailoring of CM Information Using MIL-STD-2549 Appendix A

A.4.2.2.2. **2 Tailoring.** Program-unique specifications are typically obtained via DID's such as DI-SDMP-81493 and/or DI-IPSC-81431, -81433, -61434, and -81441 (or DI-CMAN-81551 if no other appropriate DID exists) in the CDRL. Decide (1) if the Government wants to buy the originals (including all rights to change those originals) or copies <sup>4</sup> (with or without the right to review/adopt changes to those originals). (2) if the program-unique specifications are to be delivered to the Government repository, or if perpetual access is to be provided by the performing activity, and (3) whether or not to buy electronic CM data about the program-unique specifications.<sup>5</sup> See Table A-III for tailoring guidance.

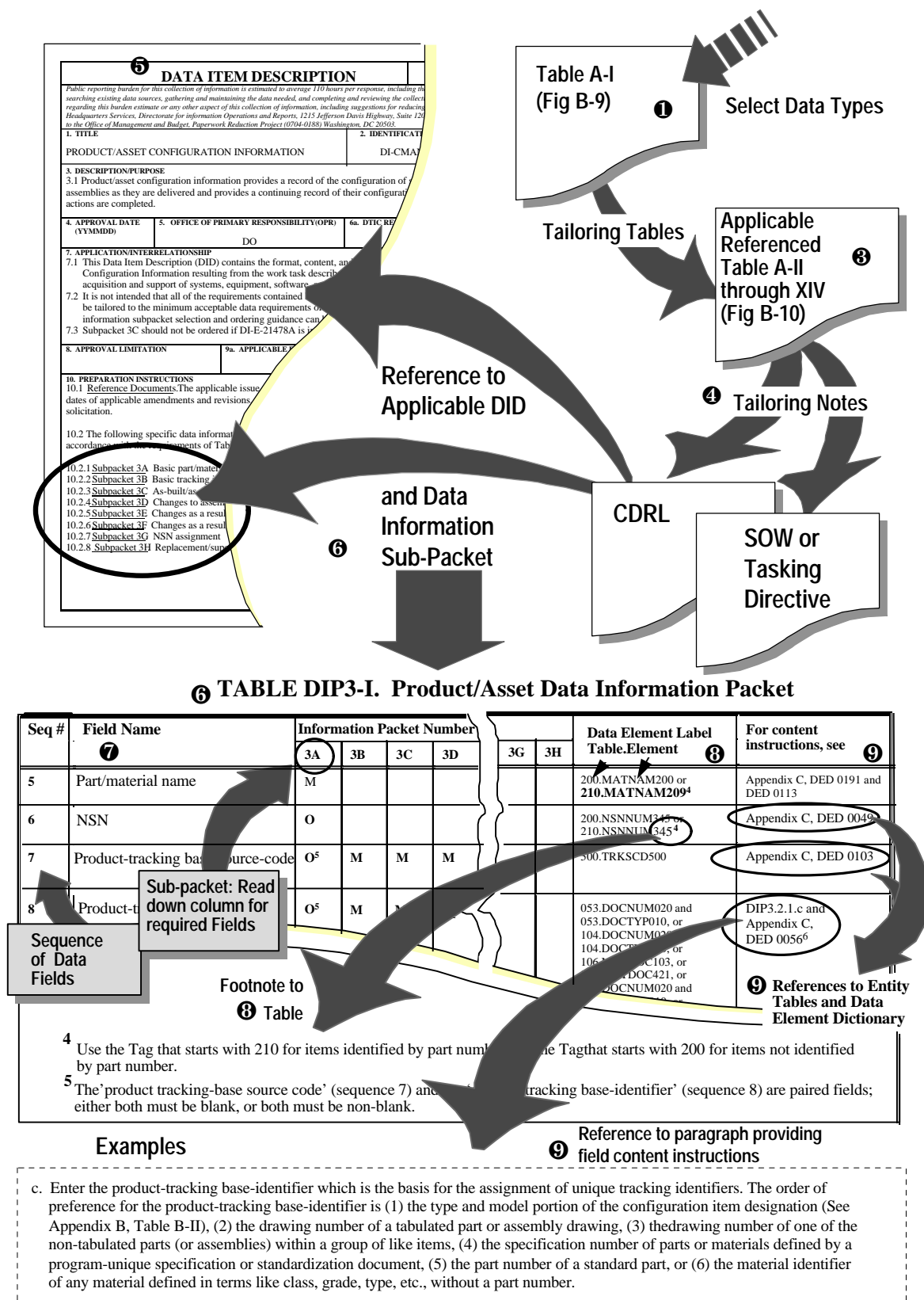
**3 Table A-III. Guidance on tailoring requirements for program-unique specifications.**

Purchase Originals or Copies	Delivery or Access	Purchase electronic CM Data	Internal Tasking or External Buy	See Notes
Originals	Delivery	Yes	Internal	a., c., and f.
		No	External	a., c., and g.
	Access	Yes	External	
		No		
Copies	Delivery			

**4 Example**

g. Cite the standardization document DID Number (or DI-CMAN-81551 if no other appropriate DID exists) in the CDRL and attach the completed TDP Option Selection Work Sheet for Specifications (if applicable) to the CDRL. In the remarks section of the CDRL, specify delivery of the documents according to MIL-STD-1840.

Figure B-10. Tailoring Paragraph and Table Examples Illustrating DID References



### Figure B-11. Invoking and Tailoring Data Information Packets